The Viscoplastic Behavior of SCS_6/Ti-15-3 Metal Matrix Composite Materials at Elevated Temperatures

by

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Titanium-based metal matrix composite materials (MMC'S) are being considered for use in the National Aerospace Plane. It is expected that these materials will be subjected to temperatures ranging up to about 820°C (1500°F). The present study was a preliminary investigation intended to quantify the level of viscoplastic behavior exhibited by SCS_6/Ti-15-3 MMC'S at elevated temperatures.

The study consisted of a series of uniaxial creep/creep recovery tests. These tests were conducted in air at a temperature of 535°C (1000°F). Three distinct types of specimens were tested: Ti-15-3 "neat matrix" specimens, $[0_2/\pm45]_S$ composite specimens, and $[90_2/\pm45]_S$ composite specimens. Tensile loads were applied to the specimens using a lever-arm creep frame equipped with a high temperature furnace. Specimen creep stains were monitored using an LVDT-based extensometer.

A typical test schedule involved heating the specimen from room temperature to 535°C at an average rate of roughly 9°C/min. The specimen was then allowed to equilibrate for 1 hour at this temperature. A creep load was applied and held constant for a 3 hr (10,800 sec) period. After the 3 hr creep period the load was removed and the creep recovery response was monitored for an additional 1 hr (3600 sec) period.

Typical results are shown in Figures 1 and 2. The creep/creep recovery response of a Ti-15-3 neat matrix specimen tested at a creep stress level of 100 MPa (14.5 ksi) is shown in Figure 1. Note that axial creep strains approaching 1% accumulated during the 3 hr creep test. Analogous results for a $[0_2/\pm45]_S$ composite specimen are presented in Figure 2. In this case the specimen was subjected to a creep stress of 142 MPa (20.6 ksi). An axial creep strain of roughly 0.07% accumulated during the 3-hr creep test.

These preliminary results indicate that titanium-based MMC's may exhibit significant creep behavior at the elevated temperatures anticipated for the NASP. Future research will investigate the creep behavior of such materials as a function of stress level, temperature, and layup.

FIG 1: Ti–15–3 NEAT MATRIX SPECIMEN #A5

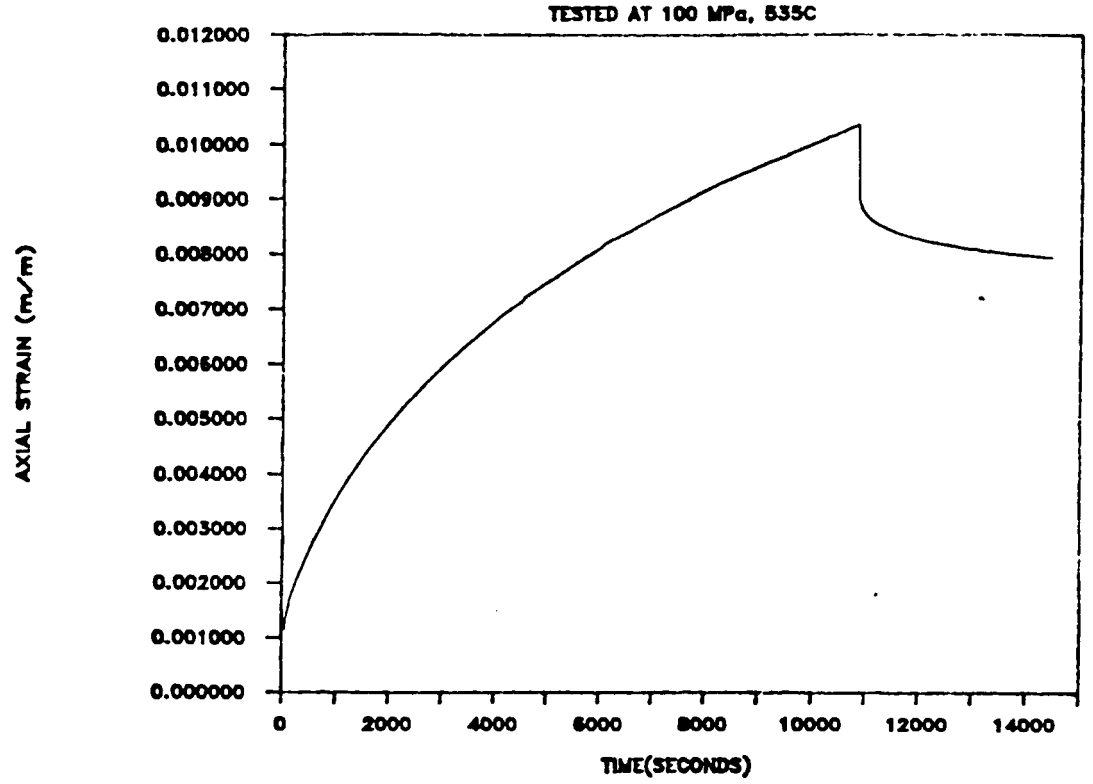

FIG 2: SPECIMEN #B10 – [0/±45]s